

AMENDMENT TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. *(Currently Amended)* A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to direct-current power produced from commercially distributed alternating-current power, the switching power supply apparatus outputting a direct-current voltage obtained by rectifying and smoothing a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation, wherein the switching power supply apparatus further comprises:
a constant current circuit that feeds a constant current to a switching control circuit for controlling the main switching device, irrespective of a magnitude of an alternating-current voltage of the commercially distributed alternating-current power, even when an the alternating-current voltage of the commercially distributed alternating current power varies.

2. *(Currently Amended)* A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to direct-current power produced from commercially distributed alternating-current power, the switching power supply apparatus outputting, via a positive and a negative output terminal, a direct-current voltage obtained by rectifying and smoothing with a rectifying/smoothing circuit a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation,

wherein the switching power supply apparatus further comprises:
an output voltage detection circuit that detects a voltage between the positive and negative output terminals;
a switching control circuit that controls switching operation of the main switching device according to detection information from the output voltage detection circuit;

a steady-state operation power supply circuit that feeds the switching control circuit with operating power produced by rectifying and smoothing a voltage that is induced in an auxiliary coil of the transformer substantially in proportion to an output voltage between the positive and negative output terminals during steady-state operation; and

a constant current circuit that receives a current from the direct-current power or the commercially distributed alternating-current power at start up to feed the switching control circuit with a constant start-up current irrespective of a magnitude of an alternating-current voltage of the commercially distributed alternating-current power.

3. *(Currently Amended)* A switching power supply apparatus having a serial circuit, including a primary coil of a transformer and a main switching device, connected between a positive and a negative power supply line connected to direct-current power produced from commercially distributed alternating-current power, the switching power supply apparatus outputting, via a positive and a negative output terminal, a direct-current voltage obtained by rectifying and smoothing with a rectifying/smoothing circuit a high-frequency voltage induced in a secondary coil of the transformer by the main switching device performing switching operation,

wherein the switching power supply apparatus further comprises:

an output voltage detection circuit that detects a voltage between the positive and negative output terminals;

a switching control circuit that controls switching operation of the main switching device according to detection information from the output voltage detection circuit;

a current detection circuit that is provided on the positive or negative output line and that short-circuits together both ends of the output voltage detection circuit when an overcurrent flows in the positive and negative output lines;

a steady-state operation power supply circuit that feeds the switching control circuit with operating power produced by rectifying and smoothing a voltage that is induced in an auxiliary coil of the transformer substantially in proportion to an output voltage between the positive and negative output terminals during steady-state operation; and

a constant current circuit that receives a current from the direct-current power or the commercially distributed alternating-current power at start up to feed the switching control circuit with a constant start-up current irrespective of a magnitude of an alternating-current voltage of the commercially distributed alternating-current power.

4. *(Currently Amended)* The switching power supply apparatus as claimed in claim 2, wherein the detection information from the output voltage detection circuit is fed to the switching control circuit through a photodiode of a photocoupler which is connected in series with the output voltage detection circuit between the positive and negative output lines and through a phototransistor of the photocoupler which is connected to the switching control circuit.

5. *(Previously Presented)* The switching power supply apparatus as claimed in claim 2, wherein the constant current circuit includes a serial circuit that is composed of a resistor and a Zener diode and that is connected between the positive and negative power supply lines and a resistor that is connected to a node between the resistor and the Zener diode and through which the start-up current is fed to the switching control circuit.

6. *(Previously Presented)* The switching power supply apparatus as claimed in claim 2, wherein the constant current circuit includes a serial circuit, composed of a bias resistor of which one end is connected to the positive power supply line and a Zener diode, and a transistor of which a base is connected to a node between the bias resistor and the Zener diode, of which a collector is connected to the positive power supply line, and of which an emitter is connected through an emitter resistor to one end of the Zener diode, the start-up current being fed from the emitter of the transistor through the emitter resistor to the switching control circuit.

7. *(Previously Presented)* The switching power supply apparatus as claimed in claim 2, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge

diodes, the start-up current being fed from one end of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit.

8. *(Previously Presented)* The switching power supply apparatus as claimed in claim 2, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the start-up current being fed from one end of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit, the switching power supply apparatus further including an oscillation frequency varying circuit that detects a voltage at a node between the constant current circuit and the reverse current prevention diode and that, by using this voltage as a drive signal, varies an oscillation frequency of the switching control circuit.

9. *(Currently Amended)* The switching power supply apparatus as claimed in claim 2, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the start-up current being fed from ~~one of nodes~~ a node between a plurality of discharge resistors connected serially between both ends of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit.

10. *(Currently Amended)* The switching power supply apparatus as claimed in claim 8, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the constant current circuit includes a serial circuit, composed of a Zener diode and a plurality of resistors, connected between the negative power supply line and ~~one of nodes~~ a node between a plurality of discharge resistors connected serially between both ends of the commercially

distributed alternating-current power, a serial circuit composed of a resistor and a reverse current prevention diode is connected between the node between the resistors and the Zener diode and the operating power for the switching control circuit, and the oscillation frequency varying circuit varies the oscillation frequency of the switching control circuit by using as a drive signal a parabolic voltage produced by a capacitor connected between one of nodes a node between the resistors and the negative power supply line.

11. *(Currently Amended)* The switching power supply apparatus as claimed in claim 2, wherein the detection information from the output voltage detection circuit is fed to the switching control circuit through a photodiode of a photocoupler which is connected in series with the output voltage detection circuit between the positive and negative output lines and through a phototransistor of the photocoupler which is connected to the switching control circuit, and the switching control circuit stops switching operation of the main switching device by detecting a decrease in a current through the phototransistor when a load is short-circuited.

12. *(Currently Amended)* The switching power supply apparatus as claimed in claim 3, wherein the detection information from the output voltage detection circuit is fed to the switching control circuit through a photodiode of a photocoupler which is connected in series with the output voltage detection circuit between the positive and negative output lines and through a phototransistor of the photocoupler which is connected to the switching control circuit.

13. *(Previously Presented)* The switching power supply apparatus as claimed in claim 3, wherein the constant current circuit includes a serial circuit that is composed of a resistor and a Zener diode and that is connected between the positive and negative power supply lines and a resistor that is connected to a node between the resistor and the Zener diode and through which the start-up current is fed to the switching control circuit.

14. *(Previously Presented)* The switching power supply apparatus as claimed in claim 3, wherein the constant current circuit includes a serial circuit, composed of a bias resistor of which one end is connected to the positive power supply line and a Zener diode, and a transistor of which a base is connected to a node between the bias resistor and the Zener diode, of which a collector is connected to the positive power supply line, and of which an emitter is connected through an emitter resistor to one end of the Zener diode, the start-up current being fed from the emitter of the transistor through the emitter resistor to the switching control circuit.

15. *(Previously Presented)* The switching power supply apparatus as claimed in claim 3, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the start-up current being fed from one end of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit.

16. *(Previously Presented)* The switching power supply apparatus as claimed in claim 3, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the start-up current being fed from one end of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit, the switching power supply apparatus further including an oscillation frequency varying circuit that detects a voltage at a node between the constant current circuit and the reverse current prevention diode and that, by using this voltage as a drive signal, varies an oscillation frequency of the switching control circuit.

17. *(Currently Amended)* The switching power supply apparatus as claimed in claim 3, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge

diodes, the start-up current being fed from ~~one of nodes~~ a node between a plurality of discharge resistors connected serially between both ends of the commercially distributed alternating-current power through a serial circuit composed of the constant current circuit and a reverse current prevention diode to the switching control circuit.

18. *(Currently Amended)* The switching power supply apparatus as claimed in claim 16, wherein the direct-current power is produced by subjecting the commercially distributed alternating-current power to full-wave rectification performed by a bridge rectifier circuit composed of bridge diodes, the constant current circuit includes a serial circuit, composed of a Zener diode and a plurality of resistors, connected between the negative power supply line and ~~one of nodes~~ a node between a plurality of discharge resistors connected serially between both ends of the commercially distributed alternating-current power, a serial circuit composed of a resistor and a reverse current prevention diode is connected between the node between the resistors and the Zener diode and the operating power for the switching control circuit, and the oscillation frequency varying circuit varies the oscillation frequency of the switching control circuit by using as a drive signal a parabolic voltage produced by a capacitor connected between ~~one of nodes~~ a node between the resistors and the negative power supply line.